PHYSICO-CHEMICAL ANALYSIS OF CONTAMINATED SOIL COLLECTED FROM DIFFERENT AREAS OF KARUR TEXTILE INDUSTRIES REGION

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Abstract: Water pollution caused by the textile industry is mainly due to the release of wastewater coming out from the wet processing operations like bleaching, dyeing, printing, etc. Karur is famous for textile dyeing and printing industries in Tamilnadu. In the present study, the Physico-chemical characteristics like pH, electrical conductivity, nitrogen, phosphorous, potassium and heavy metals like copper, iron, manganese, zinc. etc., of the soil samples contaminated by textile effluent in Karur region were analyzed using standard protocols and fluctuations in them were recorded. Soil samples were highly coloured, foul smelling, alkaline and contained heavy metal ions with concentrations values which were not in compliance with standards. The effluent from the textile industry was the major source of pollution which will affect the flora and fauna existing in such environment. Thus, there is need for treatment of textile effluent before they are discharged into the environment.

Keywords: *pollution, textile industry effluent, heavy metals, soil analysis, Karur*

INTRODUCTION

Environment pollution by industrial waste has increased tremendously with the rapid industrialization in the country[1]. The quantities and characteristics of discharged effluent vary from industry to industry depending on the water consumption and chemicals utilized in the processing units[2]. Central Pollution Control Board has listed the dye and dye intermediates industry as one of the heavily polluting industries.[3] The dye and its related industries such as textile, are thus, potent hazards to the natural sources like soil, water, flora, fauna, livestock and human, population.[4]

The Karur town is famous worldwide for its textile industries which use a variety of chemicals including dyes during processing and finishing of raw materials. A huge volume of mostly untreated textile dye wastewater is released into surface waters and seep into the ground water and adjoining water bodies. Industrial effluents contain dyes, aniline, caustic soda, acids, bleaching powder, heavy metal ions etc. Most of the heavy metals are essential for growth of organisms as micronutrients.[4] The increasing concentration of heavy metals leads to bioaccumulation of metals in fauna and flora. As heavy metals are not biodegradable, they accumulate in primary organs in the body and leads to various symptoms of disease. Several studies have been conducted by different scientists on adverse effects of textile effluents on soil and water environment. Untreated or incompletely treated textile effluent can be harmful to both aquatic and terrestrial life by adversely affecting on the natural ecosystem and long term health effects.[2]

MATERIALS AND METHODS

Top soil samples (0-10 cm) were taken at various locations from the area of Karur region, which received the washings of the textile units. The samples were collected in sterilized dry plastic bags and used for physicochemical examination.

The collected samples were analyzed for various parameters as- pH, Electrical Conductivity (EC), available nitrogen, available phosphate, potash and heavy metals by standard method.[5]

Materials and methods

Data collection and analysis: 3 soil samples (three replicates) were collected at surface level (0-10 cm in depth) from various locations. The collected samples were air dried and sieved into course and fine fractions. Well mixed samples of 2 g each were taken in 250 mL glass beakers and digested with 8 mL of aqua regia on a sand bath for 2 hours11. After evaporation to near dryness the samples were dissolved with 10 mL of 2% nitric acid, filtered and then diluted to 50 mL with distilled water. The available nitrogen was determined by the method described by Subbaiah and Asija[12]. The available phosphorus and potassium in the soil were determined by the method described by Jackson[13]. A heavy metal concentration (Cu, Fe, Mn, and Zn) of each fraction was analyzed by Atomic Absorption Spectrophotometer using GBC Avanta version 1.31 by flame Automization[14]. Quality assurance was guaranteed through double determinations and use of blanks for correction of background and other sources of error. EC of soil samples were determined from saturation extract by conductivity meter. Measurement of pH of the soil samples were done (soil and water ratio 1: 25) were done with the help of glass electrode pH meter 11-14.

RESULTS AND DISCUSSION

The soil samples collected from the textile industrial region showed great variation in the Physico-chemical properties. The soil samples were analyzed for pH, conductivity, percentage of nitrogen, phosphate, potash and heavy metals. The soil samples collected were brown to dark grey in color, giving off pungent–fishy smell. The pH of the samples was alkaline in the nature (7.4-8.8). The values were found to be higher than that of standards but more are less within the permissible limits. The values of electrical conductivity ranged from 0.19-0.81 deciS/m and were quite high for samples 3 and 4 as compared to that of samples 1 and 2 (Table1). The high value of electrical conductivity might be due to the presence of high concentration of ions and dyes contributed by numerous printing textile units. The present investigations on high pH and high electrical conductivity values of the soil samples were in agreement with the results of the survey conducted by Gupta *et al.*[6]

Table. 1: Physico-chemical analysis of the soil samples in the year 2013-2014

Parameters	permissible limit	Sample 1	Sample 2	sample 3	sample 4	Sample 5	Sample 6
PH	7-8.5	7.9	7.4	8.8	8.7	7.7	7.7
EC (deciS/m)	0-1500	2760	3930	19400	1720	845	1010
Available N (kg/ha)	0.0431-0.0646	384	473	560	477	232	324
Available P (kg/ha)	23-56	42	46.5	74.3	54.5	53.3	55.3
Available K (kg/ha)	142-337	276	307	286	635	335	333
Iron (ppm)	0.6	9.33	8.56	6.51	7.25	8.02	8
Copper (ppm)	4.5	0.395	0.478	0.207	0.546	0.541	0.454
Zinc (ppm)	0.2	1.47	1.49	0.808	0.785	1.03	1.42
Manganese (ppm)	2	6.78	5.59	3.82	2.76	4.64	4.57

The values of nitrogen (N), phosphate (P) and potash (K) concentration in the soil samples were also shows to have great variability. The amount of nitrogen ranged from 232-560 kg/ha. The concentration of phosphate of soil samples ranged from 42-74.3 kg/ha and was higher in soil sample 3 (74.3) as compared to that of the other samples which were found to be within the range. The values of potash concentration ranged from 276-

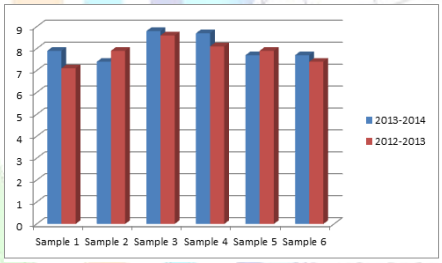
635 kg/ha and the soil sample 2 contained higher amount of potash.

Table. 2: physochemical analysis of the soil samples in the year 2012-2013

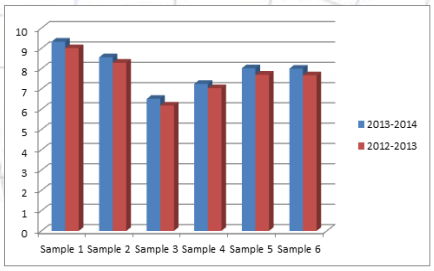
Parameters	permissible limit	sample 1	Sample 2	sample 3	sample 4	sample 5	Sample 6
PH	7-8.5	7.1	7.9	8.6	8.1	7.9	7.4
EC(deciS/m)	0-1500	2480	3710	18600	1790	948	939
Available N (kg/ha)	0.0431-0.0646	355	439	541	457	225	312
Available P (kg/ha)	23-56	40.6	44.6	71.1	52.4	51.2	52.7
Available K (kg/ha)	142-337	269	289	279	611	323	317
Iron (ppm)	0.6	9.01	8.29	6.18	7.04	7.7	7.67
Copper (ppm)	4.5	0.398	0.478	0.208	0.548	0.459	0.485
Zinc (ppm)	0.2	1.29	1.44	0.72	0.703	1.03	1.32
Manganese (ppm)	2	6.18	5.3	3.77	2.76	4.12	4.01

The analysis of heavy metal ions (Fe, Cu, Zn and Mn) of the six soil samples revealed that the values are almost same for all four samples and higher than permissible limits prescribed by ISI for industrial effluents except for the amount of copper which lies in very content. Presence of heavy metal ions (Cu, Fe, Zn and Mn) arises from material used in the dyeing process, or in a considerable amount, from metal complex dyes. Long-term irrigation with textile industrial effluents can increases EC, pH and heavy metals accumulation in soils.

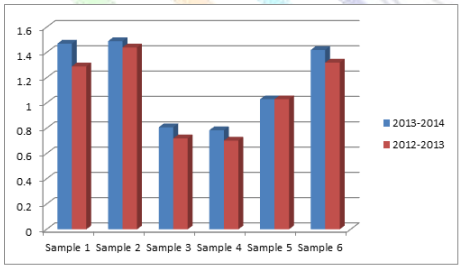
The results of the six samples collected in the year of 2013-2014 showed very close to that of the samples collected in the year of 2012-2013 except in some parameters where some deviations were.



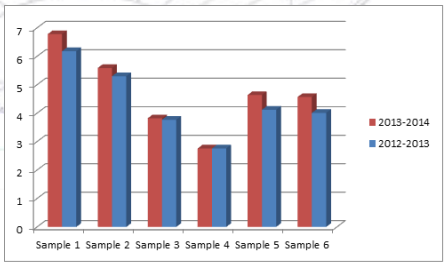
pH



Iron



Manganese



Zinc

Figure 1. Measurement of parameters (selected examples: pH, Iron, Manganese and Zinc)

observed. Though little variations, to get a trend which can yield any concluding results, we have to continuously monitor the parameters at least for half the decade in the same locations.

CONCLUSION

It can be concluded that the physicochemical analysis of soil samples collected at distinct locations in Karur region were highly coloured, foul smelling and alkaline. They contain heavy metals at concentrations which are not in compliance with standards. There is urgent need to follow adequate effluent treatment methods before their discharge to surface water for reducing their potential environmental hazards.

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